

MA3481: Mathematical Economics

Lecture 1: Course Intro & the Basics

Dr. Eleanor Denny





Introduction

- Course outline
 - Intro to options and futures
 - Using Futures
 - Interest rates
 - Options Pricing
 - Binomial Trees
 - Intro to stochastic calculus
 - Brownian motion
 - Ito's Lemma
 - Black Scholes Merton model – pricing derivatives
 - The greeks
 - What can go wrong!



Resources

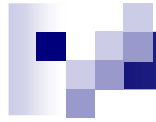
■ REQUIRED

- Hull, J. (2008), “Options, Futures and other Derivatives”, Prentice Hall. 7th Edition.

■ More detail

- Cvitanić, J & Zapatero, F. (2004), An Introduction to the Economics and Mathematics of Financial Markets, MIT press.

- Neftci, S., (2000), An Introduction to the Mathematics of Financial Derivatives, Academic Press.



Lecture material

- Slides vs blackboard
- WebCT
- Other resources



Course and Assessment

- One double lecture and one tutorial per week
 - Mondays – 2pm to 4pm in Syngé 2
 - “Brain Break”
 - Wednesdays (tutorial) – 12pm Syngé
- MA3481 = 5 credits
- 1 hand in exercise -10% each
- Final exam – 90% of total



Me!

- Office hours 11am – 1pm Mondays
 - Outside office hours please make an appointment
 - Room 3016 Economics Department

- dennye@tcd.ie



The course in one sentence ...

Investment – sacrifice something of **value** now, expecting to **benefit** from that sacrifice later.



Why should you do it? Search on Sept 22nd 2010

[Latam fixed income structurer](#) Selby Jennings \$150,000+ Bonus New York, NY, 1000122 Sep 10 My client a top tier European investment bank has a critical hire for an associate level and Vice president le...

[Front Office Quantitative Analyst - Equity Derivatives](#) Comprehensive Recruiting Outstanding compensation, base and bonus... New York City, NY 22 Sep 10 Global Investment Bank is looking to add an experienced front office Quantitative Analyst to support the firms...

[Quantitative Analyst/ PhD](#) Comprehensive Recruiting \$ Open New York City, NY 22 Sep 10 Quant Analyst with PhD and experience working with Statistical concepts and models is needed to join leading l...

[Derivative Product Manager](#) Michael Page 100,000 - 150,000 New York, NY, 1000922 Sep 10 Our Client is a Global Information Provider

[Equity Derivatives/ Exotics Trader](#) GQR | Global Quant Recruitment \$150,275k + bonus New York City, NY 22 Sep 10 Two Tier one investment banks are looking for exotics traders on their expanding desk to progress growth. The ...

[RATES DERIVATIVES SALESPERSON](#) Comprehensive Recruiting \$150,000 - \$175,000 plus bonus New York, NY 22 Sep 10 International Bank seeks experienced Fixed Income Salesperson with experience selling IR Swaps.

[Business Analyst - Strategies](#) Comprehensive Recruiting Outstanding compensation and benefit pla... New York City, NY 21 Sep 10 Global Financial firm is looking to add a Business Analyst to their Surveillance Strategies Group.

[Director, Credit Derivatives Model Validation - London](#) Integrated Management Resources Open New York City, NY 21 Sep 10 Global Derivatives Model Validation team at a Major International Bank is looking for a Director level Quantit...

[Product Control Manager](#) Not Disclosed 70,000-100,000 New York City, NY 21 Sep 10 Fixed Income Product Control Group is responsible for p&l reporting, risk reporting and all product control fu...

[Trade Support](#) Not Disclosed \$125,000 New York City, NY 21 Sep 10 Trade Support for Structured products

[Client Services Representative](#) Benchmark Solutions Competitive, based on experience New York City, NY 21 Sep 10 Benchmark Solutions is about to launch its flagship next-generation market data solution. We are looking to a...

[Interest Rate Sales- Real Money accounts](#) Comprehensive Recruiting Base \$160-175k, plus bonus New York City, NY 21 Sep 10 Experienced salesperson with established account relationships and track record of selling to large institutio...

[Director of Operational Risk](#) Not Disclosed Base salary plus bonus Chicago, IL, 60606 20 Sep 10 * 10+ years of risk management or internal audit experience. * Deep knowledge of traded investment products ...

[Product Manager- FX and IR Derivatives](#) The Tuttle Agency 100-120k base plus bonus New York, NY, 1001720 Sep 10 Our client, an international financial services firm, is looking for a Product Manager for their NYC location....

[Quantitative Algorithmic Strategist, Futures – Top Tier Investment Bank – NYC](#) NJF Search International \$150-200k base + bonus & benefits New York, NY, 1000120 Sep 10 My client is one of the leading investment banks in the world. They are currently in the process of expanding ...

[Senior Real-Time UNIX Developer](#) Focus Capital Markets \$150,000-\$200,000 New York, NY, 1000120 Sep 10 UNIX, C/C++. TCP/IP, multi threaded real time systems

[Python experts](#) Focus Capital Markets 125-175k Los Angeles, CA 20 Sep 10 Python developers needed to develop applications for our MBS trading desk

[Systems Engineer](#) Focus Capital Markets 100,000 to 175,000 Irvine, CA 20 Sep 10 The Focus Capital team is looking for senior



Today's lecture

- Introduce the basics
 - Stocks
 - Bonds
 - Indexes
 - Derivatives



Assets





The Basics

- The productive capacity of an economy is based on real assets
 - E.g land, buildings, knowledge, machines etc

The Basics

- Raising capital
 - Stocks
 - Bonds
- Financial assets
- Separation of ownership and management
- Transfer of funds





The Basics

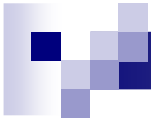
- Claims to the income generated by real assets
- Bondholders are entitled to a flow of income based on the coupon rate
- Stockholders are entitled to any residual income after bondholders and other creditors are paid
- Thus, the value of financial assets are derived from the value/productivity of the underlying real assets



The Basics

Real assets produce goods and services

Financial assets define the allocation of
wealth among investors



Stocks





Stocks

- Common stocks, equity securities, equities
- 1 share = 1 vote
- Residual claim
- Limited liability
- Preferred stock



Indexes

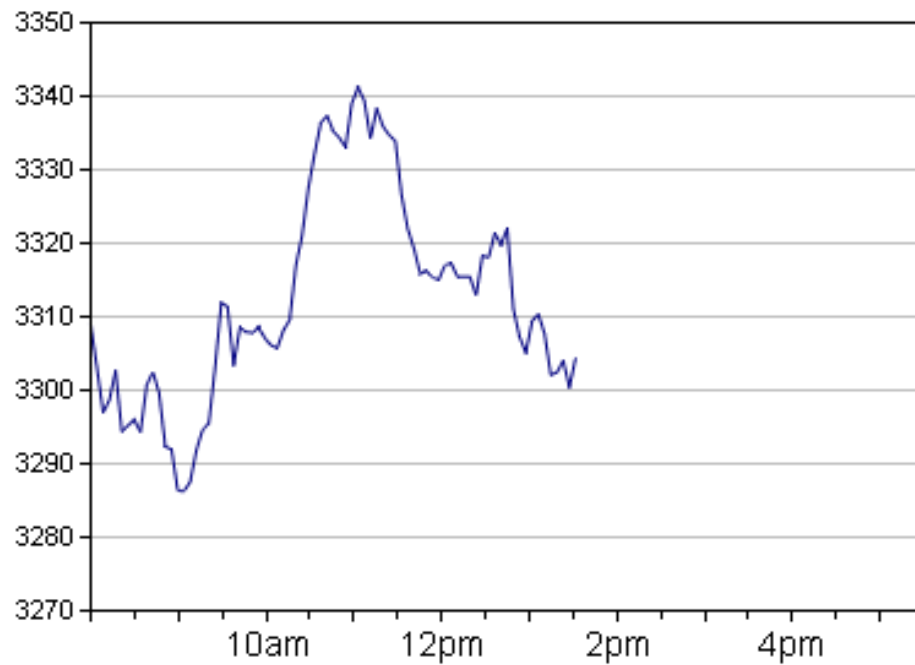
- Basket of stock
- ISEQ Overall
 - Calculation
 - ISEQ 20, ISEQ financial, ISEQ small
- FTSE100, 250, 350, SmallCap, Allshare
- CAC40, Dax30
- Dow Jones Industrial Average 30, Nasdaq 3000
- Nikkei225



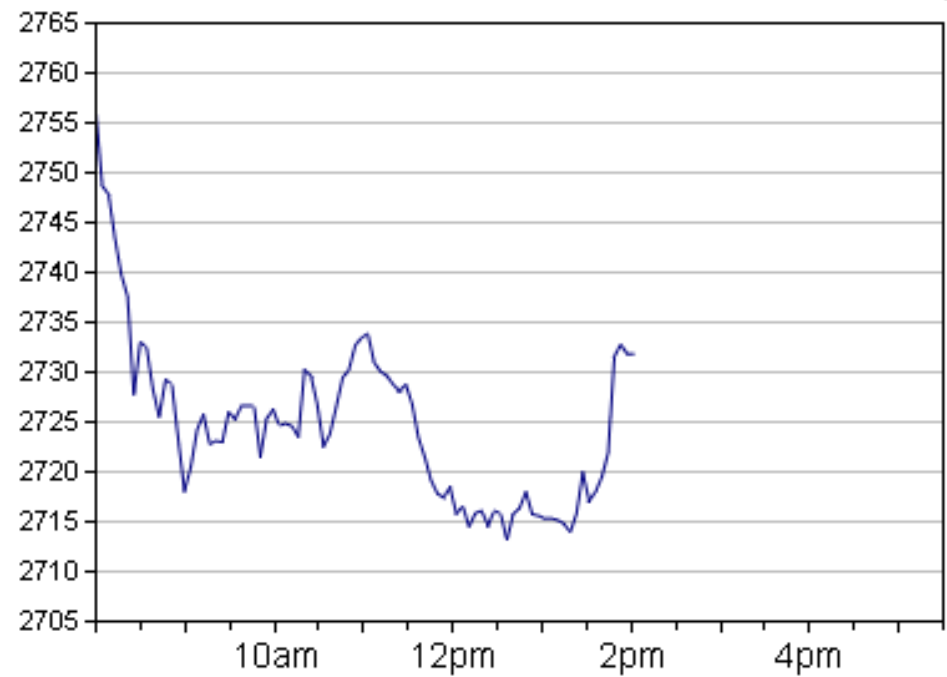
ISEQ

57 companies

Friday 25th September 2009



Wednesday 22nd September 2010





2.45pm Markets Update

Thursday, 23rd September 2010

- Disappointing US jobs figures and weak euro zone manufacturing data pulled Wall Street down at this afternoon's opening. The **Dow Jones** shed 82 points (0.8%) to 10,658, while the **Nasdaq** lost 16 points (0.7%) to 2,318.
- European markets were also down as the pace of growth in the euro zone's services and manufacturing sectors slowed much more than expected. The **FTSE** in London fell 1.2% to 5,483. **Paris** was 1.6% lower at 3,674, while **Frankfurt** was down 1.1% to 6,139.
- In Dublin, the **ISEQ** index was 40 points (1.5%) lower at 2,672, with banks weak as Irish borrowing costs rose again.


RTÉ News

<http://www.rte.ie/business/reports/marketupdate.html>



Short selling

- Selling an item you do not own with the intention of buying it back later
- In practice to short sell an asset, you must first borrow it from someone who owns it
- Then you sell it
- Buy it back at a later date and return it to original owner.



EU Temporary ban on short-selling proposed - Thursday, 16th September 2010

- EU internal markets commissioner Michel Barnier has unveiled far-reaching plans to curtail short-selling and regulate derivatives trading, opaque but popular modes of investment, which have been blamed for fanning Europe's sovereign debt crisis.
- 19 Sept 2008 "The Financial Regulator has banned short-selling in the four big Irish financial shares. It applies to AIB Group, Bank of Ireland, Anglo Irish Bank and Irish Life and Permanent. The practice of short selling has been widely criticised for hastening and even causing declines in the share prices of many stocks in recent weeks and months."



Bonds





What is a bond?

- *IOU*
- Specified payments on specified dates
- Coupon bond indenture
 - Coupon payments
 - Par (face) value
 - Maturity date
- Pricing formula



Who issues bonds?

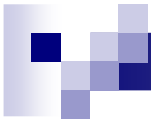
- Governments
- Companies
- Local governments – municipal bonds
- International bonds
 - Foreign – yankee, samurai, bulldog
 - Eurobonds, eurodollars, euroyen

BONDS - BENCHMARK GOVERNMENT

Sep 22	Red Date	Coupon	Bid Price	Bid Yield	Day chg yield	Wk chg yield	Month chg yld	Year chg yld
Australia	11/12	4.75	99.75	4.87	0.04	0.22	0.46	0.63
	04/20	4.50	95.42	5.11	-0.04	0.07	0.19	-0.32
Austria	07/12	5.00	107.15	0.97	-0.13	-0.08	0.09	0.02
	07/20	3.90	109.00	2.83	-0.15	0.03	0.17	-0.96
Belgium	03/12	2.00	101.47	1.01	-0.18	-0.16	0.22	-0.06
	09/20	3.75	104.95	3.17	-0.19	0.00	0.20	-0.63
France	09/12	0.75	99.78	0.86	-0.08	0.00	0.10	-0.45
	07/15	2.00	101.26	1.72	-0.11	-0.01	0.09	-0.90
	04/20	3.50	106.62	2.71	-0.09	0.00	0.11	-0.96
	04/41	4.50	122.27	3.33	-0.07	0.04	0.11	-1.02
Germany	09/12	0.75	100.00	0.75	-0.06	0.03	0.14	-0.54
	04/15	2.25	103.82	1.37	-0.11	0.03	0.07	-1.05
	09/20	2.25	99.19	2.34	-0.13	-0.03	0.07	-1.06
	07/40	4.75	135.12	2.96	-0.13	-0.01	0.04	-1.23
Greece	05/13	4.60	85.37	11.28	-0.87	-0.39	-0.41	9.04
	06/20	6.25	71.27	11.22	-0.55	-0.39	0.30	6.62
Ireland	01/14	4.00	96.80	5.07	-0.29	0.47	0.90	1.81
	04/20	4.50	87.03	6.35	-0.16	0.44	0.94	1.46

BONDS - GLOBAL INVESTMENT GRADE

Sep 22	Red date	Coupon	S*	Ratings M*	F*	Bid price	Bid yield	Day's chge yield	Mth's chge yield	Spread vs Govts
US\$										
Citigroup	01/11	6.50	A	A3	A+	101.38	1.98	-0.01	0.11	1.83
Morgan Stanley	04/12	6.60	A	A2	A	107.54	1.56	-0.45	-0.78	1.13
Household Fin	05/12	7.00	A	A3	AA-	107.58	2.27	-0.09	-0.22	1.84
HBOS Treas UK	06/12	5.50	A+	Aa3	AA-	104.06	3.04	-0.04	-0.47	2.59
Verizon Global	09/12	7.38	A	A3	A	110.51	1.82	-0.01	-0.02	1.40
Abu Dhabi Nt En	10/12	5.62	NR	A3	-	105.48	2.88	-0.14	-0.22	2.48
Bank of America	01/13	4.88	A	A2	A+	105.07	2.60	-0.08	-0.12	2.17
Goldman Sachs	07/13	4.75	A	A1	A+	106.01	2.52	0.11	0.01	1.86
Hutchison 03/33	01/14	6.25	A-	A3	A-	111.03	2.75	-0.18	-0.09	2.11
Misc Capital	07/14	6.13	A-	A3	-	107.58	4.09	-	-	2.06
BNP Paribas	06/15	4.80	AA-	Aa3	A+	106.85	3.23	0.22	0.10	1.92
GE Capital	01/16	5.00	AA+	Aa2	-	109.12	3.11	-0.16	-0.09	1.84
Erste Euro Lux	02/16	5.00	AA+	-	-	103.88	4.18	-0.05	0.01	2.82



Risk





Risk

- All assets involve some risk
- More risk tolerant investors will buy stock, less risk tolerant will buy bonds
- Bonds have fixed return. Stock has potentially higher returns



Default risk

- Rating Agencies

- Moodys: Aaa1, Aaa2, Aaa3, Aa1, ...

- S&P: AAA+, AAA, AAA-, AA+ ..

- Fitch: AAA+, AAA, AAA-, AA+ ..

- Investment Grade – BBB or Baa

- Junk/Speculative



Determinants of Government Bond Rating

- Political risk,
- Monetary stability
- Overall debt burden
- Fiscal stability
- Inflation
- Economic growth



Where in the world? S&P

USA Croatia Fiji Ecuador Iceland Turkey Italy Japan Ireland

1

2

3

4

5

6

7

**Substantial
risk to in
default
C & D**

**High Spec
B**

**Speculative
BB**

**Lower Med
BBB**

**Upper Med
A**

**High
AA**

**Prime
AAA**



Determinants of Corporate Ratings

- Firm specific

- Coverage ratios – earnings/fixed cost
- Leverage ratio – debt/equity
- Liquidity ratio – current assets/current liabilities
- Profitability

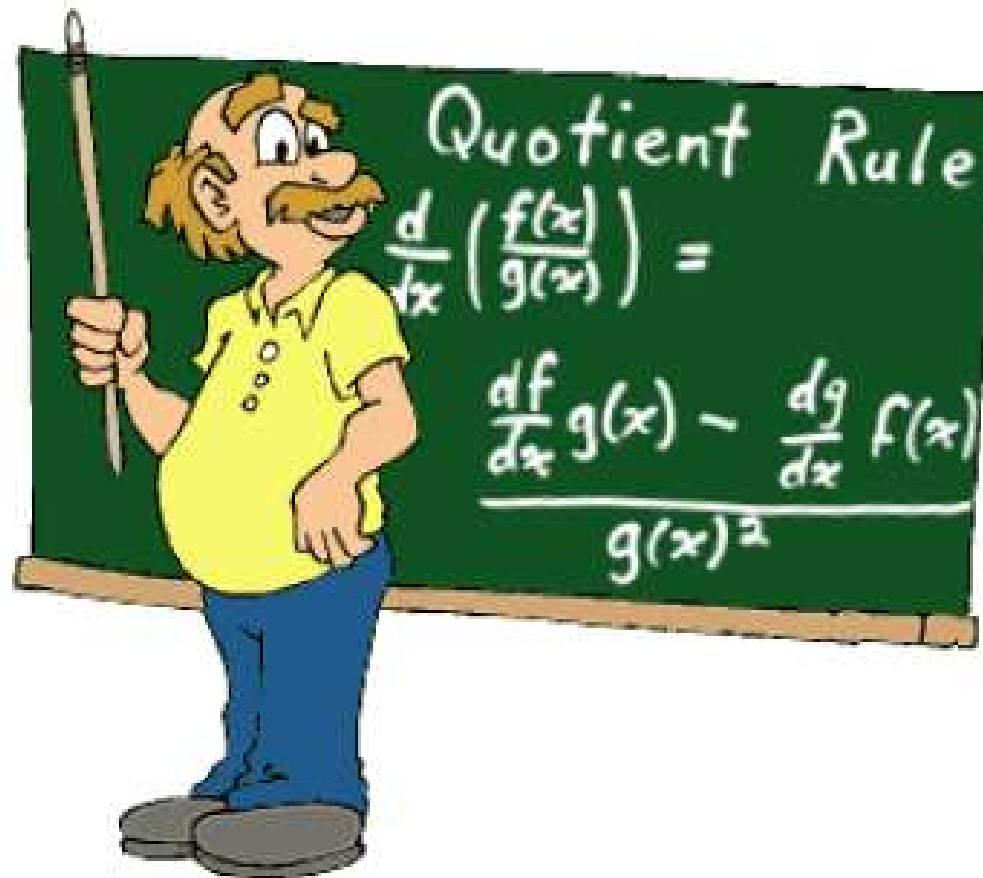
- External

- Country risk
- Industry characteristics
- Company position

BONDS - GLOBAL INVESTMENT GRADE

Sep 22	Red date	Coupon	S*	Ratings M*	F*	Bid price	Bid yield	Day's chge yield	Mth's chge yield	Spread vs Govts
US\$										
Citigroup	01/11	6.50	A	A3	A+	101.38	1.98	-0.01	0.11	1.83
Morgan Stanley	04/12	6.60	A	A2	A	107.54	1.56	-0.45	-0.78	1.13
Household Fin	05/12	7.00	A	A3	AA-	107.58	2.27	-0.09	-0.22	1.84
HBOS Treas UK	06/12	5.50	A+	Aa3	AA-	104.06	3.04	-0.04	-0.47	2.59
Verizon Global	09/12	7.38	A	A3	A	110.51	1.82	-0.01	-0.02	1.40
Abu Dhabi Nt En	10/12	5.62	NR	A3	-	105.48	2.88	-0.14	-0.22	2.48
Bank of America	01/13	4.88	A	A2	A+	105.07	2.60	-0.08	-0.12	2.17
Goldman Sachs	07/13	4.75	A	A1	A+	106.01	2.52	0.11	0.01	1.86
Hutchison 03/33	01/14	6.25	A-	A3	A-	111.03	2.75	-0.18	-0.09	2.11
Misc Capital	07/14	6.13	A-	A3	-	107.58	4.09	-	-	2.06
BNP Paribas	06/15	4.80	AA-	Aa3	A+	106.85	3.23	0.22	0.10	1.92
GE Capital	01/16	5.00	AA+	Aa2	-	109.12	3.11	-0.16	-0.09	1.84
Erste Euro Lux	02/16	5.00	AA+	-	-	103.88	4.18	-0.05	0.01	2.82

Derivatives





Derivatives

- A derivative is a financial arrangement - payments are based on the performance of some agreed benchmark
- E.g. stocks, bonds, currencies, commodities, mortgages, interest rates etc
- Two basic categories:
 - Forward-type contracts
 - Option-type contracts



Options and Forwards

- A forward-type contract commits the buyer and the seller to trade a given asset at a set price on a future date
- An option gives buyers the right, but not the obligation, to buy or sell an asset at a preset price over a specific period.

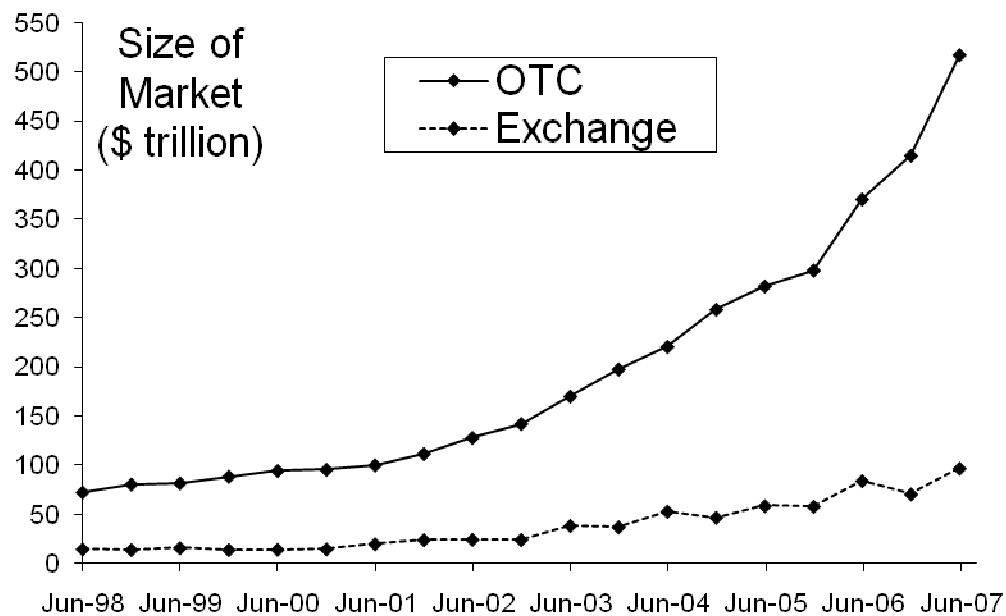


Derivatives

- Businesses often use derivatives to hedge
- E.g. to protect against currency fluctuations, commodity prices etc.
- For example, airlines and fuel prices
- Derivatives can depend on almost any variable – even the amount of snow fall in a ski resort!

Where are they traded?

- Exchange
- Over-the-counter



Types of Traders

- Hedgers
- Speculators
- Arbitrageurs
- Dangers!
 - Nick Leeson
 - Arbitrageur between futures prices on Singapore and Osaka exchange
 - Moved into speculation and lost \$1 billion, caused collapse of Barings bank





This course

- Look at a variety of different derivatives
- Different pricing mechanisms
- Introduction to stochastic calculus

- Derivation of the MOST important formula in derivatives pricing
 - Black, Scholes, Merton Formula
 - Winner of Nobel Prize in Economics

EVENTS ANNUAL HAMILTON LECTURE

event 15 October 2010 | 19:00



I have 5 tickets to give away

Venue: Trinity College

OBSERVATIONS ON MATHEMATICAL FINANCE IN THE PRACTICE OF FINANCE

Robert C. Merton is the Chaired Professor of Finance at the MIT Sloan School of Management. He was the George Fisher Baker Professor of Business Administration (1988-98) and the John and Natty McArthur University Professor (1998-2010) at the Harvard Business School, where he is now Emeritus. He previously served on the finance faculty of the Sloan School from 1970 until 1988. Professor Merton received the Alfred Nobel Memorial Prize in Economic Sciences in 1997 for a new method to determine the value of derivatives...[More details](#)



Important Information

- NB: Get the book asap
 - Come to tutorials (although not this week!)
 - Do the practice questions!
 - Check WebCT frequently
 - Don't fall behind
-
- Evaluation in week 5 and week 12